PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Apparatus and process for Pasteurizing Egg Products

We, THE BALLAS EGG PRODUCTS CORPORATION of 40 North 2nd Street, Zanesville, Ohio, United States of America, a Corporation of the State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to matter consumed by humans and animals, to the treatment of such matter for various purposes including rendering the same suitable for combination with other substances, for preservation, to render the same ready for consumption, and relates also to method and apparatus employed in such operations.

The invention relates particularly to egg products, to the treatment of such egg products, and to the removal of deleterious pathogenic organisms such as Salmonella.

The problem of adequately processing foods in order to facilitate the killing of pathogenic bacteria and rendering the product fit for consumption with a minimum deterioration of the functional quality of the finished product has been indeed perplexing to the food industry. The advent of food technology and microbiology has served to eliminate and control many of the problems encountered by industry today, an excellent example of which improvements is in the dairy industry.

Heat treatment, either by itself or combined with another process, has probably become the most widely used method for the killing of bacteria in foods. One of the greatest drawbacks with the use of heat is best illustrated in its applications to the heat labile egg whites. Present methods of heating egg whites prior to pasteurization require an adjustment of the pH to 6.6—7.0. This acidification of the raw whites is done to stabilize the ovalbumin, lysozyme, ovomucoid, and the viscosity of the whites at moderate heating temperatures. The addition of iron and aluminium salts is required to stabilize the conalbumin fraction. Without these recommended adjustments and additions to the egg whites, undesirable changes will occur to the physical properties as a result of the heat. There are some distinct disadvantages in this method of stabilising the whites prior to heat treatment. The iron salts used to stabilize the conalbumin can affect an accelerated growth rate among the small number of organisms that survive the heating process.

While eggs to be pasteurized may undergo treatment without the necessary additions required by whites alone. The fact that the whole egg can be pasteurized without coagulation may be attributed to its relatively low pH, and to the fact that there is enough iron already present in the yolk to react with the conalbumin and thus stabilize the egg white portion of the whole egg. Ideally, the processor would want a product which, after treating, would retain most of its raw properties, and yet be free of any viable Salmonella organisms. Prior to the present invention only one of these criteria could be satisfied at one time with any degree of certainty.

It is an object of the invention to provide a relatively simple method of and an apparatus for the heat processing or pasteurization of egg products, including egg whites, in a practical and efficient manner effectively destroying Salmonella and other undesirable organisms without altering the physical characteristics of the eggs.

According to one aspect of this invention we provide a process for treating egg products to destroy deleterious pathogenic organisms which includes removing a major portion of the trapped air in the egg products while they are at a temperature below that at which they coagulate and pasteurising the egg products. Preferably the trapped air is removed by subjecting the egg products to a partial vacuum,

The egg products may be subjected to a pre-pasteurisation heat treatment by passing them in heat exchange with the pasteurised egg products and the trapped air removed by subjecting the egg products to a partial vacuum between the pre-pasteurisation heat treatment and the pasteurising step.

According to another aspect of this invention we provide an apparatus for pasteurising liquid egg products comprising a regenerator having a first part for preheating the egg product prior to pasteurisation in heat exchange with a second part for cooling the product after pasteurisation, a pasteurising heater and holding tubes connected in series between the first generator part and the second generator part, means for cooling the product after it is discharged from the second regenerator part, and means for subjecting the product to a partial vacuum before the product is subjected to the action of the pasteurising heater.

Preferred forms of the present invention will now be described with reference to the the accompanying drawings wherein:

Fig. 1, a layout of an air removal and pasteurizing system in accordance with the present invention;

Fig. 2, a somewhat different layout of the same system;

Fig. 3, a somewhat different layout of a system for accomplishing the same result but with the sealed vacuum chamber in the system following the first heating step; and

Fig. 4, a somewhat different layout of the system of Fig. 3.

Briefly stated, the invention provides an apparatus and process for the pasteurization of egg products to kill deleterious, pathogenic organisms such as Salmonella and others from egg whites and includes a removal of entrapped air and gases which would tend to insulate and interfere with complete pasteurization. The invention also includes the subjecting of the egg whites or other egg products to heat to produce pasteurization and the combination and use of elements in the apparatus in a manner to produce the desired result. The apparatus generally includes means for maintaining a low liquid level in the vacuum chamber, for removing liquid against the operation of the vacuum, the controlling of the liquid removal from the vacuum chamber, the arrangement of the heating and cooling units for heat exchange of maximum efficiency, as well as the maintenance of the product at the desired temperature for a sufficient length of time during the process.

In the preferred practice of the invention there is provided a system which includes a feed or supply tank 10 for containing the egg whites or egg products to be pasteurized or otherwise treated. This tank preferably is of stainless steel or it may be of plastics material or any other desired character, it being necessary that the entire system have interior surface inert to bacteria. In this tank the egg whites or egg products to be treated are introduced at a temperature of approximately 40°F, or U.K. health, authorities approved operating temperatures.

The product is drawn from this tank 10 through a discharge line 11 by means of a pump 12 and the product is discharged through a line 13 for treatment, such line being provided with a check valve 14 permitting flow in only one direction.

The system of the present invention may include a sealed vacuum chamber 15, the upper portion of which may connect with the line 13 in the first system, or the vacuum chamber may be located further along in the system after a heating step. The chamber 15 is reduced as near as possible to a perfect vacuum, it having been found that in the process of pasteurization much useless and inefficient work is performed when air and gases are present while on the other hand in pasteurization in the absence of air and gases, most efficient work can be accomplished and at a lower temperature.

Referring to the first system of Figs. 1 and 2, a jet type vacuum pump 16 is connected by a line 17 with the upper end of the vacuum chamber 15 which, preferably, is an elongated cylinder with its axis upright, means being provided for maintaining a liquid level 18 within the lower end of such chamber by suitable means which may include a float 19 and/or may include other mechanisms which will hereinafter be described.

Liquid is removed through a line 20 from the vacuum chamber by means of a removal pump 21 and liquid from said pump is discharged through a line 22, a throttle or volume control valve 23, a check valve 24, and a line 25 into a timing pump 26, from which it is discharged through a line 27 into a regenerating unit 28 which, with a heater 29, holding tube 30, and chiller 31 constitute the principal elements of the pasteurizer.

The timing pump 26 is correlated with the removal pump 21 in a manner to maintain the liquid level 18 in the vacuum chamber. Liquid discharged by the timing pump will pass into the regenerator at approximately 40° F, substantially the temperature of the liquid in the feed or supply tank, where its temperature will be subjected to heat to raise its temperature from 40° F to 104°F. The liquid at this elevated temperature will pass through an opening into the heater 29 where its temperature will be elevated to approximately 130° F. Liquid at 130° F will be retained in a holding tube 30 for approximately 3½ minutes to effect killing of the Salmonella or other undesirable bacteria.

After its retention in the holding tube the liquid will pass through a flow diversion valve 32 where any liquid below the 130° F temperature will be returned through a line 33

to the feed or supply tank 10, while liquid at the 130° F temperature will be returned through a line 34 to the regenerator 28 where it will come into heat exchange relation with liquid entering through the supply line 27 at 40° F, thus reducing the 130° F temperature back to near 104° F, after which the liquid will pass through a passage into the chiller 31 where the temperature will be further reduced to a temperature of approximately 38° F prior to its discharge from the cooling unit 31, through a line 35.

As stated instead of the liquid from the supply or feed tank being discharged directly into the vacuum chamber 15 it may be discharged directly into the regenerator 28 as illustrated in Fig. 3, and from the regenerator the liquid may flow through the line 13 and check valve 14 to the vacuum chamber 15. Thereafter liquid may be driven from the vacuum chamber through the line 20 by means of the removal pump 21 from whence it can pass through line 22, throttle valve 23, check valve 24, and line 25 to the timing pump 26 and then through a line 28 to the heater 29. From the heater 29 the liquid can flow into the holding tube 30 then to the flow diversion valve 32 with liquid that is too cold passing directly through line 33 to the feed or supply tank and liquid at the appropriate temperature can pass through line 34 and then into the regenerator 28 and then through a direct connection into the chiller 31 and be discharged therefrom through line 35.

Practice of the invention with the vacuum chamber before and after the regenerating chamber has been tried to determine the effect of the temperature on air removal either procedure being effective. The more air removed, the more thorough was the heating at a given temperature. The egg whites used in the initial study were freshly broken, all were taken from the same lot and they were placed in three holding tanks with contents weighing 2,200 pounds each and chilled to a temperature of approximately 40° F to evaluate the bacteria logical properties of the process with suspension of known concentrations of Salmonella organisms mixed and added to two of the three 2,200 pound tanks. The uncontaminated tank of egg whites was processed by the method of Figs. 1 and 2 first. A raw sample was taken as well as three random samples during the process at varying temperatures and rates of flow. The results of these samplings follow:

TABLE I

Number	Description	Salmonella Isolation	Total count	Coliform count
1.	Control-Raw	Neg.	300,000	TNC
2.	Uncontaminated heat treated 136°F. R/F 3,000 pounds/hr	Neg.	6,400	10
3.	Uncontaminated heat treated 136°F. R/F 2,600 pounds/hr	Neg.	6,800	10
4.	Uncontaminated heat treated 142°F. Heat 132°F. Hold R/F 2,500 pounds/hr	Neg.	6,300	10

The second 2,200 pound holding tank to be processed by the first method was contaminated with a mixed culture of Salmonella organisms, and agitated for 2 hours. Raw samples were taken, and subsequent samplings were made throughout the process. The tabulated results are present in Table 2 as follows:

TABLE 2

Number	Description	Salmonella Isolation	Total count	Coliform count
5.	Contaminated control prior to heat treatment	pos.	300,000	TNC
6.	Contaminated heat treated 140°F. Heat 136°F. Hold	neg.	880	10
7.	Contaminated heat treated 141°F. Heat 132°F. Hold	neg.	780	10
8.	Contaminated raw sample mid-tank	pos.	300,000	TNC
9.	Contaminated heat treated 137°F. Heat 136°F. Hold	neg.	650	10
10.	Contaminated raw sample	pos.	300,000	TNC
11.	Contaminated heat treated 137°F. Heat 136°F. Hold	neg.	1,000	10
12.	Contaminated raw sample	pos.	300,000	TNC
13.	Contaminated heat treated 135°F. Heat 135°F. Hold	neg.	1,000	10

At this point the apparatus was disinfected, and rinsed before disassembling and arranging for the placement of the vacuum chamber after the regenerator (method 2). A raw sample, before contamination, was taken from the 3rd 2,200 pound tank — contaminated and mixed. Further samplings of the egg whites were taken after contamination, during the process, at intervals of varied rates of flow and temperature. These results are presented in Table 3 as follows:

TABLE 3

Number	Description	Salmonella Isolation	Total count	Coliform count
14.	Uncontaminated Control Raw	neg.	300,000	TNC
15.	Contaminated Heat treated 136°. Hold R/F 2,880 pounds/hr	neg.	1,000	10
16.	Contaminated Heat treated 136°F. Hold R/F 3,060	neg.	1,000	10
17.	Contaminated Heat treated 135°F. Hold R/F 3,880 pounds/hr	neg.	1,000	10
18.	Contaminated Heat treated 134°F. Hold R/F 2,820 pounds/hr	neg.	1,000	10
19.	Contaminated Raw mid-tank	pos.	300,000	TNC
20.	Contaminated Heat treated 134°F. Hold R/F 2,820 pounds/hr	neg.	1,000	10
21.	Contaminated Heat treated 133°F. Hold R/F 2,820 pounds/hr	neg.	1,000	10

The results thus far, in the investigation, readily show the effectiveness of this apparatus bacterially. It was found also, that the second method effected a greater kill than the first, and that physical properties of the eggs appeared more acceptable.

To determine exactly where the bacteria were being killed in the second method, a series of valves were attached to the apparatus at varied locations.

A fourth 2,200 pound lot of whites was processed, and during the process samplings were made: (1) raw (2) after regeneration before vacuum chamber (3) after regeneration and vacuum chamber before heat (4) at flow diversion (F/D) valve (5) final chilled product. The results of which are presented in Table 4:

TABLE 4

Number	Description	Salmonella Isolation	Total count	Coliform count
1.	Control Raw	neg.	300,000	TNC
2.	After regeneration (104°F.) Before vacuum chamber	pos.	300,000	TNC
3.	After regeneration and vacuum treatment	neg.	300,000	TNC
4.	After heat treatment at F/D valve	neg.	1,000	10
5.	Final product (chilled)	neg.	3,000 (1,400)	10
6.	After regeneration (104°F.) Before vacuum chamber	neg.	300,000	TNC
7.	After regeneration and vacuum treatment	neg.	300,000	TNC
8.	After heat treatment at F/D valve	neg.	3,000 (2,100)	10
9.	Final product (chilled)	neg.	3,000 (1,300)	10
10.	Water Before	neg.	1,000	10
11.	Water After	neg.	8,800	10

With reference to Samples 10 and 11, it should be mentioned that air drawn from the vacuum chamber is passed through a vessel of water. The water in the vessel was tested before pasteurisation so as to determine where the Salmonella kill takes place.

The results of running the egg whites through air vacuum at heat side after the regenerator section are presented in Table 5, as follows:

TABLE 5

Tank No. 1

Number	Description	Salmonella Isolation	Total count	Coliform count
1.	Raw liquid egg whites broken 8/24 sent to past. without cooling liquid to Past. 70°F.	neg.	820,000	87,000
2.	Liquid whites after Past. beginning of tank	neg.	5,400	L.T.10
3.	Liquid whites after Past. middle of tank	neg.	1,600	L.T.10
4.	Liquid whites after Past. bottom of tank	neg.	2,400	L.T.10

* All above samples run at 130°F. at flow rate of 3,000 pounds on Sample No. 2 and at 2,640 on Samples 3 and 4.

Number	Description	Salmonella Isolation	Total count	Coliform count
5.	Liquid whites after Past. at 129°F. and 2,640 pounds flow	neg.	6,100	L.T.10
Tank No. 2				
1.	Raw liquid whites before Past.	neg.	2,360,000	87,000
2.	Liquid whites after Past. begin. of tank	neg.	5,400	L.T.10
3.	Liquid whites after Past. middle of tank	neg.	4,000	L.T.10
4.	Liquid whites after Past. bottom of tank	neg.	11,100	L.T.10

** (referring to preceding Table 5) At a pasteurization temperature of 130°F., hold 3½ minutes the kill based on total count was 99.62% effective and at 124°F. for 3½ minutes the kill was 99.26% effective. At a temperature of 133°F. for 3½ minutes hold the kill based on total count was 99.71% effective. Since no Salmonella was found in raw liquid whites, we cannot determine effectiveness on Salmonella.

The references in the above Examples to "heat" and "hold" refer to the temperatures in the heater and the holding tubes respectively.

It will be apparent from the foregoing that apparatus and a process or method are provided for the treatment of egg products at a low heat to protect the functional properties thereof while at the same time effectively destroying Salmonella and other undesirable micro-organisms. By means of the apparatus and process set forth air and gases are removed from the product, and the product is heat treated with such heat treatment materially simplified by the absence of air and gases rendering unnecessary the use of stabilization additives.

WHAT WE CLAIM IS:—

1. A process for treating egg products to destroy deleterious pathogenic organisms which includes removing a major portion of

the trapped air in the egg products while they are at a temperature below that at which they coagulate and pasteurising the egg products.

2. Process according to claim 1, wherein the trapped air is removed by subjecting the egg products to a partial vacuum.

3. Process according to claim 1 or claim 2, wherein the pasteurisation temperature is maintained for approximately 3½ minutes.

4. Process according to any preceding claim, wherein the egg products are egg whites.

5. Process according to any preceding claim wherein the egg products are subjected to a pre-pasteurisation heat treatment at 40°F. to 104°F.

6. Process according to any one of claims 1 to 5, wherein the egg products are subjected to a pre-pasteurisation heat treatment by passing them in heat exchange with the pasteurised egg products and in which the trapped air is removed by subjecting the egg products to a partial vacuum between the pre-pasteurisation heat treatment and the pasteurising step.

7. A process according to claim 1 substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

8. Egg products treated by the process claimed in any preceding claim.

9. An apparatus for pasteurising liquid egg products comprising a regenerator having a first part for pre-heating the egg product prior to pasteurisation in heat exchange with a second part for cooling the product after pasteurisation, a pasteurising heater and holding tubes connected in series between the first generator part and the second generator part, means for cooling the product after it is discharged from the second regenerator part, and means for subjecting the product to a partial vacuum before the product is subjected to the action of the pasteurising heater.

10. Apparatus according to claim 9 wherein the last mentioned means is located between the first regenerator part and the pasteurising heater.

11. An apparatus substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

FORRESTER, KETLEY & CO.,
Chartered Patent Agents,
Jessel Chambers,
88—90 Chancery Lane,
London, W.C.2, and
Rutland House, 148 Edmund Street,
Birmingham 3.
Agents for the Applicants.

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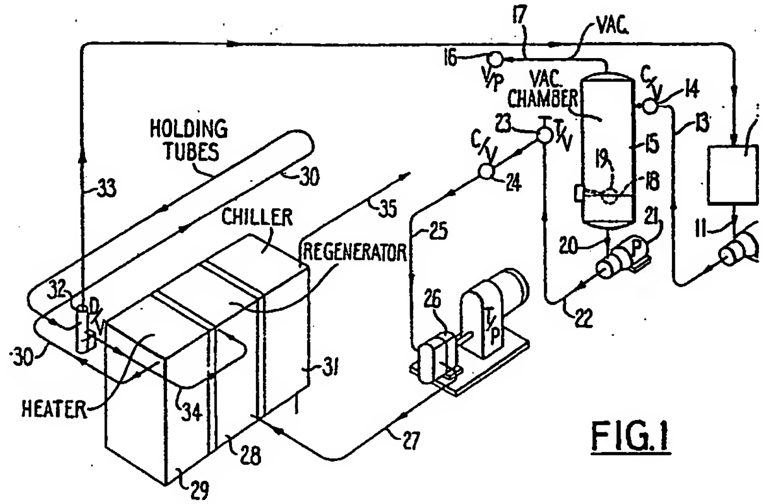
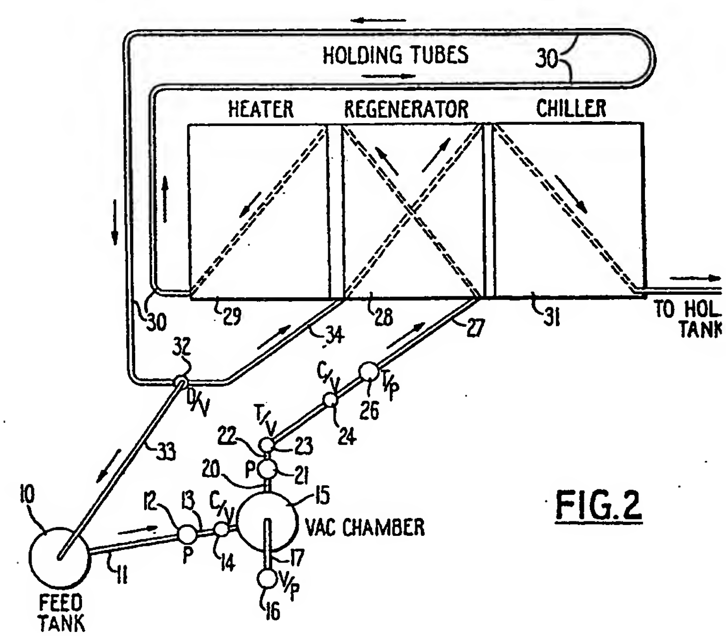

17
VAC.
16
V/P
VAC.
CHAMBER
C/V
14
HOLDING
TUBES
23
T/V
13
C/V
15
30
19
18
33
24
35
CHILLER
25
21
11
REGENERATOR
20
32
D/V
26
T/P
22
30
31
HEATER
34
28
27
29

FIG.1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P
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12
13
C/V
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P
VAC CHAMBER
14
17
11
V/P
FEED
TANK
16

FIG.2

1134189 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 1 & 2

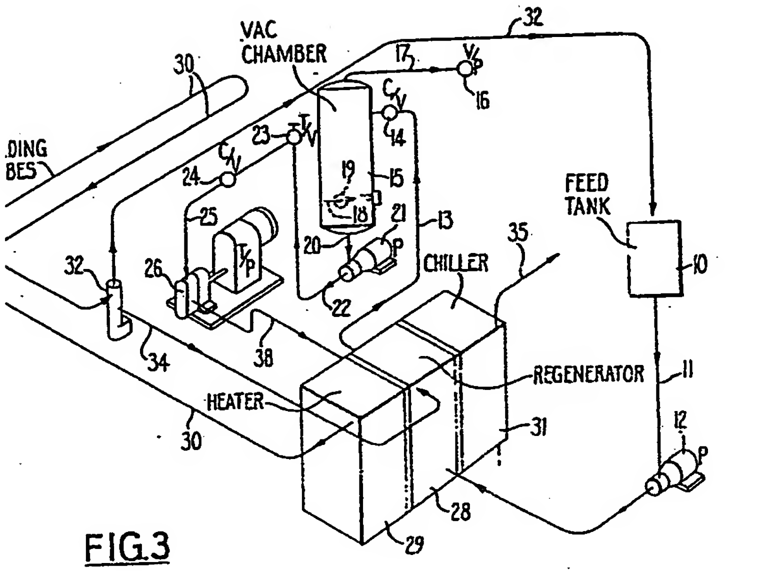

FIG.3

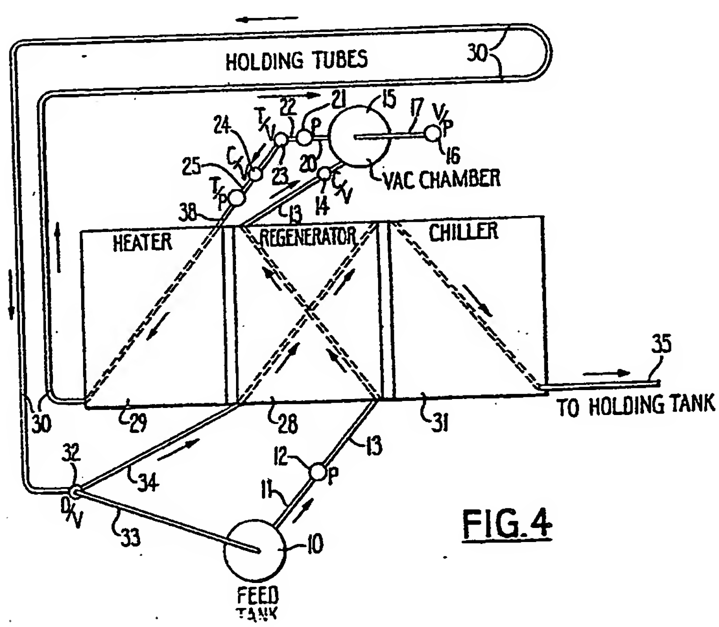

FIG.4

1134189 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 1 & 2

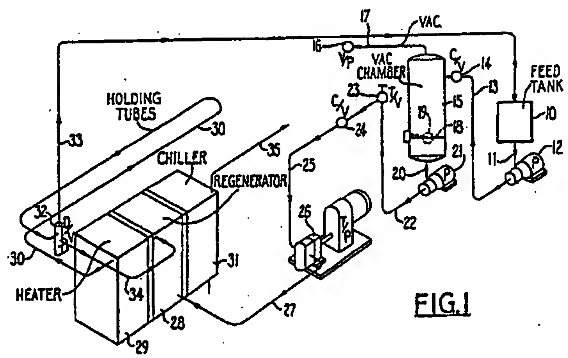

FIG.1

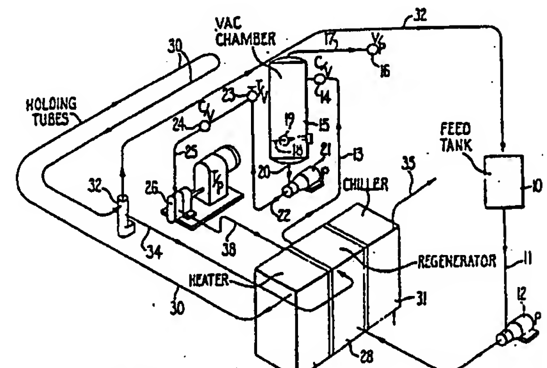

FIG.3

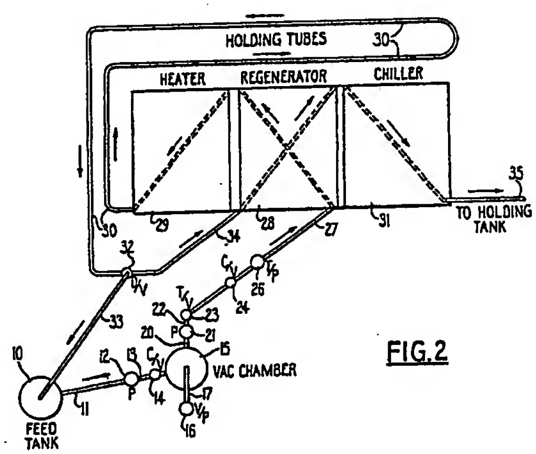

FIG.2

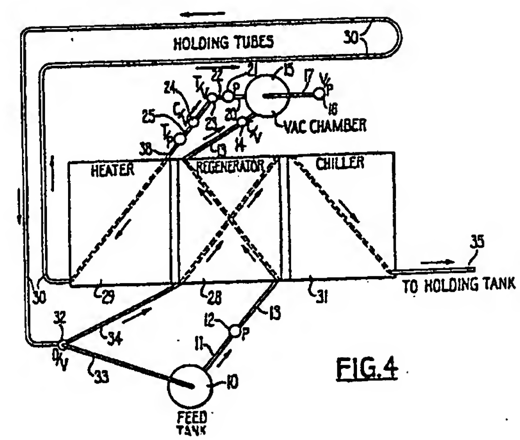

FIG.4